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Document 14.5
Safe Handling of Mercury and Mercury Compounds

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14.5

Safe Handling of Mercury and Mercury Compounds*

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* **Minor revision**

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Safe Handling of Mercury and Mercury Compounds

1.0 Introduction

Mercury is a liquid metal that is environmentally persistent and bioaccumulates in the food chain. Mercury is present in both organic and inorganic forms. The inorganic form can be further divided into elemental mercury and mercuric salts. Organo-mercury consists of long and short alkyl and aryl compounds. Elemental mercury evaporates at room temperature and reacts with many elements to form salts, amalgams, and organo-mercury compounds (see Appendix A for definitions). Elemental mercury and some mercury compounds are listed in state and federal regulations as hazardous wastes.

This document contains

- Precautions and controls for safely handling metallic mercury and its compounds.
- Specific guidance for avoiding or limiting metallic mercury spills.
- Guidelines for cleaning up mercury spills.

All LLNL personnel who work with mercury shall comply with the controls specified in Section 3.0 of this document to prevent adverse health effects resulting from mercury use or spills.

2.0 Hazards

2.1 Toxicity and Hazards

All forms of mercury are toxic. Mercury poisoning can result from inhalation, ingestion, and injection or absorption through the skin. Elemental mercury poses a health hazard because it is volatile. Elemental mercury, as a vapor, penetrates the central nervous system, where it is ionized and trapped, attributing to its extreme toxic effects. Elemental mercury is not well absorbed by the gastrointestinal tract; therefore, when ingested, it is only mildly toxic. Mercury metal and mercury compounds are highly hazardous if inhaled or if they remain on the skin for more than a short period of time. Dimethyl mercury rapidly penetrates intact skin. Depending on the type of mercury and dose, symptoms may appear relatively quickly or take a number of years to appear.

Listed below are various forms of mercury and their effects and hazards.

- **Mercury vapor (i.e., elemental mercury)** is readily absorbed through inhalation and can also pass through intact skin. After absorption, elemental mercury is carried by the blood to the central nervous system where it is oxidized. The oxidation product produces injury. Persons heavily exposed to elemental mercury will develop worsening tremors of the hands, shyness, insomnia, and emotional instability (e.g., the symptoms of the Mad Hatter in *Alice in Wonderland*—a caricature of hat makers who cured felt in pools of mercury.) Mercury vapors can reach very high levels when the liquid is heated. Such levels will cause adverse effects in humans almost immediately if workplace controls are inadequate. Some equipment, such as thermometers, vacuum pumps, manometer, and sphygmomanometers, may contain mercury.
- **Mercury salts** (e.g., mercuric nitrate) are highly toxic and corrosive. They accumulate mostly in the kidney causing renal damage.
- **Organo-mercury compounds** attack the nervous system causing tremors, impaired vision and hearing, and paralysis. These compounds may also cause birth defects. The effects from exposure to excessive levels of airborne mercury or skin contact with mercury compounds may not be noticeable for months or years.
- **Mercury fulminate, $Hg(ONC)_2$,** is a detonator used in explosives.
- **Mercury(II) oxide** is an oxidizer. It can cause organic materials to start burning in the same manner as any strong oxidizer.
- **Dimethyl mercury**, an extremely toxic material, is a colorless, sweet-smelling liquid. It is a severe fire hazard, with a flash point of –4°C. This material rapidly penetrates the skin resulting in severe exposure from very minor quantities, which can be fatal. Extreme caution is required when working with this material and when selecting personal protective equipment (PPE).

Contact the ES&H Team for more specific hazards and controls for mercury and its compounds, as well as the manufacturer's material safety data sheet (MSDS). Additionally, Section 6.2 of this document contains a Uniform Resource Locator (URL) where more information and the MSDSs for several forms of mercury can be obtained. Other MSDSs also can be found on the LLNL web-based MSDS server at the following Internet address:

http://ctmsds.llnl.gov:1650/livehtml/MSDS/MSDS1.html

2.2 Exposure Limits

A worker's exposure to mercury shall be less than the concentrations established by the American Conference of Governmental Industrial Hygienists (ACGIH) and the Occupational Safety and Health Administration (OSHA). Following are the maximum 8-hour-average concentration levels permitted:

- Mercury metal vapor—0.025 mg/m^3.
- Mercury salts—0.025 mg/m^3.
- Aromatic organic compounds—0.1 mg/m^3.
- Alkyl compounds—0.01 mg/m^3. (The ceiling limit for these compounds is 0.03 mg/m^3.)

3.0 Controls for Handling Mercury and Mercury Compounds

Planning and documentation are required for all operations involving the use of mercury. This section contains controls for preventing unnecessary exposure and minimizing the likelihood and extent of mercury spills. (See Document 2.1, "Laboratory and ES&H Policies, General Worker Responsibilities, and Integrated Safety Management," and Document 2.2, "Managing ES&H for LLNL Work," in the *Environment, Safety, and Health (ES&H) Manual* for details.) Guidelines for cleaning up a mercury spill can be found in Appendix B.

3.1 Engineered Controls

The following controls shall be available for activities involving the use of mercury:

- Adequate ventilation or vapor-containment systems. See Document 12.2, "Ventilation," in the *ES&H Manual* for more information.
- Mercury spill-control kits. These should be in areas where >1 ml of mercury is used (except thermometers and sphygmomanometers). Contact the ES&H Team for guidance on procuring the appropriate spill kit and for instructions on how to use it. Mercury vacuum cleaners are available from the area ES&H Team.
- Safety showers/eyewashes should be installed where mercury work is done routinely. Requirements for training the users of eyewashes/safety showers are found in Section 3.1.3 of Document 10.2, "LLNL Health Hazard Communication Program," in the *ES&H Manual* (for non-laboratory situations), and Section 3.2.6 of Document 14.2, "LLNL Chemical Hygiene Plan for Laboratories," in the *ES&H Manual* (for laboratory situations).

Requirements for the testing of safety showers/eyewashes are specified in Appendix B of Document 14.1, "LLNL Chemical Safety Management Program," in the *ES&H Manual*. Engineering specifications are found in LLNL Facility Standard PEL-M-11610, "Emergency Eyewash and Shower Units."

- Catch basins and pans made of smooth impervious material (e.g., plastic or smooth-finish paint) and with edge lips.

  Note: Steep lips are more effective than gentle rises in trapping spilled mercury.

  Make sure that the basins are large enough to contain the greatest amount of mercury that could spill and catch mercury droplets escaping from any plausible direction. It may be useful to place felt or horsehair mats on seamless plastic sheets in or under catch pans to capture mercury leaks from the equipment. Droplets of mercury can then be collected by simply wrapping up the plastic with the mat still inside and disposing of it as mercury waste. Section 3.2.8 contains more information on the disposition of hazardous materials.

- Removable plastic shield, mercury traps, and blow-out valves for mercury manometers.

Concrete floors sealed with epoxy and working surfaces with few crevices are preferred for work involving mercury. Carpeted areas should never be used.

3.2 Administrative Controls

The administrative controls listed in this section are to be implemented when mercury and its compounds are involved in operations.

3.2.1 Hazards Assessment

Before beginning any LLNL operation involving the use of metallic mercury, mercury compounds, or equipment containing mercury, the Responsible Individual shall

- Prepare an Integration Work Sheet (IWS) for the operation. Become familiar with the hazards associated with the materials for the particular operation and implement the necessary controls. It is also recommended that the MSDS be obtained for each mercury compound, describing its hazards and controls.
- Determine if the worker's current training is adequate for the activity. Section 3.2.2 contains ES&H training requirements.

- Contact the ES&H Team about each new use of mercury, except for sealed items such as thermometers. The ES&H Team will
  - — Provide guidance on the selection of controls and assistance with job-specific training.
  - — Evaluate the operation to determine if air permits are required or the appropriate National Environmental Policy Act (NEPA) documentation has been prepared and approved.
  - — Recommend the workplace monitoring for mercury as needed.
  - — Determine if a written safety plan is necessary for operations that involve heating or using large quantities of mercury or its compounds. The Team may waive the LLNL requirement for a safety plan (contained in Document 2.2) if the quantity is small (so that one/half of the vapor limits in Section 2.2 are not exceeded) or for totally enclosed systems. An Integration Work Sheet with Safety Plan (SP) is always required when using dimethyl mercury.

3.2.2 Training

Workers who potentially may be exposed to mercury shall be trained in the hazards and controls before initial assignment as described in Document 10.2. Contact the ES&H Team for additional training as needed in the following areas:

- Safe use of mercury.
- Mercury hazards.
- Cleanup of small spills. (Appendix B contains cleanup guidelines.)
- Proper use of mercury vacuum cleaners. Workers who use breakable or open equipment containing >10 ml of metallic mercury shall receive training in the proper use of mercury vacuum cleaners and other spill cleanup procedures.
- Use of PPE including respirator training. See Document 11.1, "Personal Protective Equipment," in the *ES&H Manual* for details.

3.2.3 Work Practices

Mercury users shall be aware of and follow work practices listed below.

Dimethyl mercury. This chemical is so toxic that its use always requires a SP. In addition, inner (silver shield, 4H, or other brand laminate-style gloves) and outer gloves (heavy-duty nitrile or neoprene, with long cuffs) should be considered as a minimum when handling, using, or working with dimethyl mercury.

For all forms of mercury, the following work practices apply:

- Avoid using mercury whenever possible. Use alternative instruments that have no mercury (i.e., alcohol or digital thermometers and aneroid barometers) to measure temperature or pressure.
- Depending on the type and concentration involved and the work to be done, additional PPE may be required. Contact the ES&H Team industrial hygienist for assistance.
- Do not eat, drink, or smoke; or store food, drinks, smoking materials, or cosmetics in areas where mercury is in use.
- Avoid skin and eye contact. Use rubber or plastic gloves when handling metallic mercury. **DO NOT** use lightweight disposable gloves for heavier jobs, as these can tear easily and allow mercury to lodge under the fingernails or contact other parts of the skin. When the operation may result in exposure to the face, wear splash-proof goggles and a face shield unless full-face respiratory protection is being used.

  Note: Quantitative permeation or penetration information is scarce on the type of gloves or protective clothing that offer protection from exposure to mercury compounds.
- Wash hands and face after handling mercury, before lunch or breaks, and at the end of the work day.
- Avoid working with mercury on surfaces with cracks (e.g., tile seams, spaces between wood boards, baseboards, wall coving, gaps between table legs and floors), crevices, and hard-to-reach spaces; porous surfaces (e.g., carpets, wood, and crinkle-texture paint), and false floors.
- Avoid storing or handling mercury near sinks. Spilled mercury could run into the sink, lodge in the trap, ruin the pipe by amalgamating with and weakening the metal, and then be released into the environment or a retention tank system designed only for dilute solutions in rinse water.
- Avoid using mercury or mercury compounds in operations that could generate mercury wastestreams contaminated with radionuclides since it is expensive or impossible to dispose of this type of mixed wastestream.
- Transfer of liquid mercury between containers should be carried out in a fume hood over a tray or pan to confine any spills.

3.2.4 Medical Surveillance

The Health Services Department will determine the need for biological monitoring or medical surveillance examinations of workers with potential mercury exposure based on

an evaluation of the operation; workplace controls; and any relevant human factors as well as input received from the activity leader, affected workers, and the ES&H Team.

3.2.5 Label and Storage

The following controls apply to the labeling and storage of mercury and its compounds:

- Label all containers of metallic mercury and its compounds.
- Label all mercury containers as follows:

  WARNING: VAPOR HARMFUL AT ROOM TEMPERATURE—MAY BE FATAL IF HEATED IN THE OPEN—DO NOT BREATHE VAPOR—USE WITH ADEQUATE VENTILATION—AVOID SKIN CONTACT.

- Do not store mercury near chemicals that can create explosive mixtures with mercury (e.g., acetylene, ammonia, boron phosphodiiodide, chlorine dioxide, methyl azide, and ground sodium carbide) or radioactive materials. Keep mercury compounds that are oxidizers separate from organic materials and other combustibles.
- Minimize the amount of mercury in use or in storage.
- Store liquid mercury in a cool place.
- Use containers made of impact-resistant material or put them in sturdy secondary containers.
- Keep mercury containers tightly closed when not in use.

  Avoid cutting cartons that contain plastic bottles filled with mercury. A plastic bottle could be torn open and cause a mercury spill.

3.2.6 Packing and Shipping

Use horse hair, Kimpak, or bubble pack as packing material for mercury containers.

Table 1 contains the packing and shipping requirements from Document 21.2, "Onsite Hazardous Materials Packaging and Transportation Safety Manual," in the *ES&H Manual* for all mercury containers and objects having mercury.

3.2.7 Mercury Spill Cleanup

Elemental mercury is usually easy to work with under normal conditions (e.g., in a fume hood). However, spills involving elemental mercury that are ignored or improperly addressed can cause serious problems because

- Mercury is dense (specific gravity ~13.5). Large drops shatter into numerous small droplets that can move at great speed across long distances.
- Droplets and vapors tend to congregate in crevices. Porous materials can become contaminated and may have to be disposed of as mercury waste (see Section 3.2.8) because they are too difficult to decontaminate.

Table 1. Container requirements for mercury and its compounds.[a,b]

if	then use	and
The material is to be transferred within a lab or, at most, to a different lab in the same building	The original container.	Hand carry the material or use a cart if it is too heavy.
The material is to be transferred to an onsite facility that is a short distance away (i.e., at most, between labs in nearby buildings)	A sealed, labeled, and shatter-resistant container.	Hand carry the material. Use a cart if the material is <1 gallon or transport it by truck if it is >1 gallon. Do not use a bicycle to transport the container.
The material is to be transferred to an onsite facility that is far away	A double container. The inner container should be sealed, labeled, and made of shatter-resistant material. The outer container should be filled with horse hair, Kimpak, or bubble pack; or sweeping compound if oil or other contaminants are present.	Hand carry the material. Use a cart if material is <1 gallon or transport it by truck if it is >1 gallon. Contact the Radioactive and Hazardous Waste Management (RHWM) field technician for assistance with moving containers of hazardous waste having mercury. Do not use a bicycle to transport the container.
The material is to be shipped to an offsite facility	The packaging and labels required by DOT regulations.	Contact • The Traffic Office for assistance in determining DOT or LLNL packing requirements. (Elemental mercury and mercury compounds are subject to federal and state transportation regulations.) • The Procurement and Materiel Shipping Office for advice with packaging the item. • The RHWM field technician for assistance with packaging hazardous waste containing mercury. Packaging shall meet the requirements in the *Waste Acceptance Criteria Manual* (UCRL-MA-115877, Rev. 2., November, 2003).

[a] Objects containing mercury can be shipped onsite "as is" in their original shatter-proof casings if they are durably sealed and labeled.

[b] See Document 21.5, " Requirements for Transfer of Equipment and Property for Repair, Reuse, Maintenance, Storage, Excess, or Scrap," in the *ES&H Manual* for onsite or offsite reuse requirements.

- Mercury amalgamates with other metals. Metal objects are weaker after contamination with mercury and may be unsuitable for further use; those soiled by spilled mercury often cannot be decontaminated and, therefore, may have to be disposed of as mercury waste (see Section 3.2.8).
- Microorganisms convert metallic mercury to organo-mercury compounds, which are more hazardous in some species than the metallic form. This creates a significant environmental problem, particularly when mercury gets into the aquatic food chain.
- Mercury will bioaccumulate in the environment and, if eaten by animals, the mercury contamination can be passed up the food chain.

If a mercury spill occurs,

1. Block off any area where droplets of spilled mercury are visible using tape or rope and post signs (such as below) made of any available material.

MERCURY SPILL—Keep Out!

2. Avoid walking on or touching surfaces contaminated with mercury.
3. Promptly notify the area ES&H Team. The ES&H Team will survey the area to determine the airborne concentration of the spill, adjust the boundaries of the blocked-off area as needed, and provide technical support.
4. PPE specifically designed for use with mercury is available for unusual situations and for spill cleanup.

If a mercury spill is too large to clean up safely or workers are injured or contaminated, call 911. Small spills of metallic mercury usually can be cleaned up safely by the workers involved if they have had the proper training.

Note: Area ES&H Teams provide training upon request.

Mercury spill kits are available from Material Distribution Division, Bulk Issue. Use of vacuum cleaners/shop vacuums for mercury spills is prohibited. Only use specially designed and dedicated mercury vacuum cleaners. Specific guidance on appropriate spill-control equipment is available from the area ES&H Team. Detailed guidance for cleaning up mercury spills can be found in Appendix B.

3.2.8 Mercury Waste Collection and Disposal

Federal and state environmental agencies have hazardous-waste criteria for mercury compounds and wastestreams. Generators of mercury-contaminated wastestreams shall evaluate the waste to determine if any of the hazardous-waste criteria has been exceeded.

Equipment or objects containing mercury but no longer needed by a program should be evaluated in accordance with Document 21.5, "Requirements for Transfer of Equipment and Property for Repair, Reuse, Maintenance, Storage, Excess, or Scrap," in the *ES&H Manual* before shipment to other onsite or offsite organizations for reuse. The equipment should be managed as waste only if it cannot be reused onsite or released for offsite use. The amount of mercury contamination present in the equipment will determine if it shall be managed as hazardous or industrial waste. Equipment or objects characterized as hazardous waste shall be prepared for transport and disposal through the Radioactive and Hazardous Waste Management (RHWM) Division. Hazardous waste in the generator facilities shall be managed in accordance with the regulatory requirements for Satellite Accumulation Areas and Waste Accumulation Areas. In some cases, mercury can be recovered/recycled from contaminated equipment (by an outside company), instead of having to handle it as hazardous waste. Contact RHWM for advice and resources.

Individuals who generate mercury waste at LLNL can use the following resources to assist them in managing their wastestreams:

- Document 36.1, "Hazardous, Radioactive, and Biological Waste Management Requirements," in the *ES&H Manual.*
- *Waste Acceptance Criteria contains* information on characterizing wastestreams, preparing appropriate documentation, and preparing waste for storage or transportation.
- The Training Manual used in Course EP0006, "Hazardous Waste Generation and Certification." This document provides hazardous waste generators with information necessary to perform their hazardous waste operations, including spill cleanup response, in compliance with legally binding requirements and LLNL policies and procedures.

If additional information is needed, generators may contact the following:

- RHWM field technician for assistance in waste cleanup, packaging waste, and completing the necessary paperwork.
- ES&H Team Environmental Analyst for guidance on characterizing wastestreams, waste generator storage requirements, and obtaining disposal requirements for all mercury determined to be waste.

3.2.9 First Aid

Personnel contaminated with dimethyl mercury shall do the following—immediately:

1. Wash the affected area using either an eyewash station or safety shower, as appropriate.

2. Report to the Health Services Department. Be sure to inform the Health Services clinician of the quantity of mercury involved.

Personnel contaminated with mercury metal or other mercury compounds should exercise the following precautions:

1. Immediately wash the affected area using either an eyewash station or safety shower, as appropriate.
2. Report to the Health Services Department. Be sure to inform the Health Services clinician of the type, quantity, and physical state of mercury involved.
3. Use a mercury vapor sniffer (available from the ES&H Team) to make sure there is no mercury in the space under the fingernails. If necessary, clean the area with soap, water, and a scrub brush; then, recheck with the sniffer to ensure that all of the mercury is removed. *Do not use the solutions that come with mercury cleanup sponges or powders for personal decontamination—some are corrosive!*
4. Remove and place contaminated clothing in a plastic bag. LLNL will provide replacement underclothes and coveralls and reimburse workers for lost clothing.

Personnel who are not contaminated should handle any spill cleanup only if they are trained. Contact the H&S Technician for assistance.

Note: Contact the ES&H Team environmental analyst for guidance on managing wastewater from safety showers or eyewash stations. The ES&H Team environmental analyst shall be notified if any cleaning water is discharged into the sanitary sewer system.

4.0 Responsibilities

General responsibilities for all workers are described in Document 2.1. Specific responsibilities for safely handling mercury and its compounds are listed under each title.

4.1 Responsible Individual

The Responsible Individual, which may be a manager or work supervisor, shall ensure that all workers who might handle mercury are trained in accordance with the provisions of this document and follow established work practices.

4.2 Workers

- Follow the handling precautions for mercury specified in this document and in procedures cited or included as part of the authorizing IWS.
- For additional guidance on the safe handling and disposition of mercury, contact your area ES&H Team.

4.3 Hazards Control Department

- Provide support and training to anyone who handles mercury or cleans up mercury spills.
- Loan mercury vacuum cleaners to organizations, as needed.
- Ensure that mercury vacuum cleaners are maintained in good working condition.
- Provide the necessary respiratory protection to workers. See Document 11.1 for details.

4.4 Environmental Protection Department

4.4.1 Hazardous Waste Management Division

- Determine the proper storage, packaging, and disposal requirements for mercury-contaminated waste.
- Provide waste containers and/or spill cleanup materials to LLNL programs, upon request.
- Provide spill clean up personnel.

4.4.2 Operations and Regulatory Affairs Division (ORAD)

Assist Laboratory organizations with

- Characterizing mercury-contaminated wastes.
- Determining proper cleanup procedures for mercury spills.
- Evaluating operations for compliance with air regulations.
- Evaluating new operations for NEPA coverage and prepare all appropriate documentation.
- Identifying and approving the proper disposal requirements for any mercury-contaminated water.

4.5 Environmental Services Laboratory

The Environmental Services Laboratory within the Chemistry and Materials Science Directorate is responsible for analyzing wastestreams (e.g., liquid and solids) that contain hazardous constituents potentially above hazardous waste limits.

4.6 Health Services Department

The Health Services Department provides medical testing and surveillance, biological monitoring, and examinations to personnel who have the potential for significant exposure to mercury.

5.0 Work Smart Standards

22 CCR 66262, "California Standards Applicable to Generators of Hazardous Waste."

22 CCR 66266.120, "California Requirements for the Management of Waste Elemental Mercury."

29 CFR 1910, Subpart Z, "Toxic & Hazardous Substances."

29 CFR 1910.94, "Ventilation."

29 CFR 1926, Subpart Z, "Toxic & Hazardous Substances."

40 CFR 262, "Standards Applicable to Generators of Hazardous Waste."

49 CFR 100-199, "Research and Special Programs Administration."

ACGIH *Industrial Ventilation Manual*, 23rd edition (1998).

*ACGIH TLVs and BEIs: Threshold Limit Values for Chemical Substances and Physical Agent*s, 2002 (excluding Biological Exposure Indices, TLVs for Physical Agents, and Biologically Derived Airborne Contaminants).

ANSI Z88.2-1992, "American National Standard for Respiratory Protection."

ANSI Z9.5-1992, "American National Standard for Laboratory Ventilation."

UCRL-AR-128189, Rev. 1, "LLNL Occupational Medicine Standard: Medical Evaluation of Employees."

6.0 Resources for More Information

6.1 LLNL Contacts

If you have questions about this document or need additional information, contact

- ES&H Team
- Respirator Services
- Radioactive and Hazardous Waste Management Division

6.2 Chemical Information [LLNL access only]

The MSDSs for mercury, mercury compounds, or other materials of interest are available at the following Internet address:

http://ctmsds.llnl.gov:1650/livehtml/MSDS/MSDS1.html

MSDSs also can be obtained by

- Calling the MSDS Hotline (ext. 4-4404)
- Sending an email request to MSDS@llnl.gov

6.3 Other Sources

National Institute for Occupational Safety and Health (NIOSH), *Pocket Guide to Chemical Hazards*, 1994.

R. J. Lewis, ed., Sax's Dangerous Properties of Industrial Materials, Van Nostrand Reinhold Company (1994).

Waste Acceptance Criteria, Lawrence Livermore National Laboratory, Livermore, CA (UCRL-MA-115877, Rev.2), November 2003. This document can be accessed at the following Internet Address:

http://www.llnl.gov/es_and_h/wac_rev2/wac_contents.html

Appendix A

Terms and Definitions

Absorption	A method whereby a substance can pass through intact, unbroken skin.
Amalgam	A mixture or alloy of mercury with other metals.
Catch pan/basin	A secondary container used to collect minor spills.
Central nervous system	Parts of the nervous system, including the brain and spinal cord.
Industrial waste	Any waste from industrial processes versus common office wastes. Contact your ES&H Team environmental analyst for information on the regulatory levels for identifying hazardous waste.
Manometer	An instrument used to measure gas and vapor pressure.
Mercury salts	Inorganic mercury compounds.
Mercury vacuum	A specially designed type of vacuum cleaner used to collect spilled mercury safely.
Metallic mercury	Mercury that is in its elemental state.
Organo-mercury compounds	Mercury compounds that include carbon atoms, bonding directly to the mercury.
Sphygmomanometer	An instrument used for monitoring blood pressure.

Appendix B

Guidelines for Cleaning Up Elemental Mercury Spills

Respond promptly to all spills and accidents involving any hazardous chemical.

Contact the ES&H Team for assistance in cleaning up a small spill. A small spill is a release that meets *all* of the following criteria:

- Nature and potential hazard of material is known.
- The incident results in no injury or just minor injury requiring simple first aid.
- Release presents no actual or potential threat to human health, the environment, or property.

Any spill that exceeds any of the above criteria is considered a "large" spill. For large spills call 911.

The following guidelines apply when cleaning up mercury spills:

- Use sufficient protective clothing (see Table B-1) to keep mercury droplets off your personal clothing and skin. This includes plastic or rubber gloves, disposable foot covers (whenever mercury is on the floor), and additional protective clothing when in doubt of the proper clothing to use. *Never use thin disposable gloves, as these can tear and allow mercury to lodge under the fingernails.*
- Use the buddy system when respirators are required. Watch the color of the end-of-service indicators on the faces of the other people's cartridges and have them replaced when the indicators change color. Be careful not to drag airline respirator hoses through mercury. Check the hoses with a mercury sniffer for contamination before storing or returning them to Respirator Services.
- Spread plastic sheets over surfaces onto which mercury could drop or run during spill cleanup. Tape the sides of the sheets to the floor.
- Remove any dust or oil into which mercury may have lodged during spill cleanup. Use detergent or a solvent to remove oil or grime or a vacuum to remove dust. Be certain to adhere to the controls specified in this document during spill cleanup.
- Dip rags in cleaning solutions once. Never dip a dirty rag in a clean solution, for this will contaminate the solution and the container. Minimize the amount of mercury-contaminated liquid generated during cleanup, as it is expensive to dispose of contaminated liquid wastes.
- Use mercury kits with hand-powered miniature vacuums or sponges to clean up spills whenever practical.

Table B-1. Protective equipment to be used for mercury spill cleanup.[a]

Item
Impervious gloves, plastic
Shoe covers, disposable
Booties, heavy soled
Apron, laboratory—large and heavy
Apron, laboratory—small and light
Disposable coveralls without hood (blue)
Disposable coveralls without hood (white)
Disposable coveralls with hood (white)
Respirator, cartridge[a]
Respirator, airline[b]

[a] Use of this respirator shall be approved in advance by the area industrial hygienist. Respirator Services issues this type of respirator to workers who are trained in its use, medically qualified, and who have no facial hair that will interfere the respirator's effectiveness.

[b] Airline hoses and equipment shall be "sniffed" for mercury contamination before they are returned to Respirator Services or to the proper storage location.

- To avoid the spread of contamination, never sweep mercury-contaminated dirt or blow it off of surfaces with compressed-air nozzles. Instead, vacuum or seal it off in place.
- Use flowers of sulfur or "HgX" powder to seal in place mercury that has entered crevices inside buildings. These materials do not absorb or neutralize mercury, but form hard shells around the droplets that seal in the vapor. Mercury can also be sealed into crevices with sealer or caulk. These techniques should be used only when necessary (e.g., when removal is prohibitively time consuming or expensive), because trapped mercury can be a health hazard to those who work on affected surfaces in the future. A sign indicating that sealed mercury is present may be needed. Notify the area ES&H Team and environmental analyst before sealing any mercury in place.

  Mercury spills that occur outside buildings shall be completely cleaned up.
- Use a specially designed and dedicated vacuum cleaner (available from the area ES&H Team) for cleaning up large mercury spills. Check the vacuum's exhaust with a mercury sniffer before using it and remove as much mercury as possible from inside the vacuum after using it—too much residual mercury can ruin the mercury absorber. Do not use a regular or HEPA vacuum cleaner to clean up mercury spills because mercury amalgamates with copper in the

motor, and the vacuum will exhaust high concentrations of mercury vapor into the air. The vacuum then becomes dangerous to use or decontaminate and ultimately shall be discarded.

- Use Resisorb to eliminate mercury vapors near surfaces, particularly after removing liquid mercury from those surfaces.
- Contact the area RHWM and H&S field technician for assistance in cleanup operations and/or to determine the appropriate packaging requirements for bulky items that may be contaminated with mercury.
- Place used rags, cleaning materials, protective gear, and mercury-contaminated gear into plastic bags. Cut up mops and other large tools before placing them into the bags. Gently squeeze excess air from the bags, then place the sealed bags into drums and affix a completely filled out Hazardous Waste Label to the drum. Contact the area RHWM field technician for assistance in completing the Waste Disposal Requisition Form. The RHWM field technician will transfer the drum to a Waste Accumulation Area.
- Have the ES&H Team conduct a clearance survey before removing any access barriers. The spill area cannot be returned to normal use until this survey is completed.
- Call the area ES&H Team Environmental Analyst if mercury-contaminated water enters into a retention tank. The environmental analyst will then notify the appropriate persons in the Environmental Protection Department so that arrangements can be made for the water's analysis and proper disposal.